

Booster Corrector 3D Analysis

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Magnet specification is shown in Table 1, calculated values in Table 2 and corrected to match the specification in Table 3. **ARMCO steel properties used in calculations.**

Table 1

Type	Integrated field/gradient	Max slew rate
Horizontal dipole	0.009 T-m	0.5 T-m/s
Vertical dipole	0.015 T-m	0.8 T-m/s
Normal quadrupole	0.16 T	160 T/s?
Skew quadrupole	0.008 T	0.8 T/s
Normal sextupole	1.41 T/m	2800T/m/s
Skew sextupole	1.41 T/m	2800T/m/s

Table 2

Type	Integrated field / gradient	Aperture field / gradient	Eff. length, m	Current, A	Number of turns	DC Resistance, Ohm	Inductance, mH
Horizontal dipole	0.0157 T-m	0.0357 T	0.44	38.1	208	0.315	14
Vertical dipole	0.0157 T-m	0.0357 T	0.44	38.1	208	0.315	14
Normal quadrupole	0.176 T	0.49 T/m	0.36	64.8	128	0.105	2.2
Skew quadrupole	0.0115 T	0.031 T/m	0.37	2.7	168	1.68	4.0
Normal sextupole	2.0 T/m	5.87 T/m ²	0.34	39.8	132	0.263	2.5
Skew sextupole	2.0 T/m	5.87 T/m ²	0.34	39.8	132	0.263	2.5

Table 3

Type	Integrated field / gradient	Aperture field / gradient	Current, A
Horizontal dipole	0.009 T-m	0.02 T	23
Vertical dipole	0.015 T-m	0.0357 T	37
Normal quadrupole	0.16 T	0.22 T/m	60
Skew quadrupole	0.008 T	0.021 T/m	2
Normal sextupole	1.41 T/m	4.1 T/m ²	30
Skew sextupole	1.41 T/m	4.1 T/m ²	30

Version 1. All windings at maximum currents

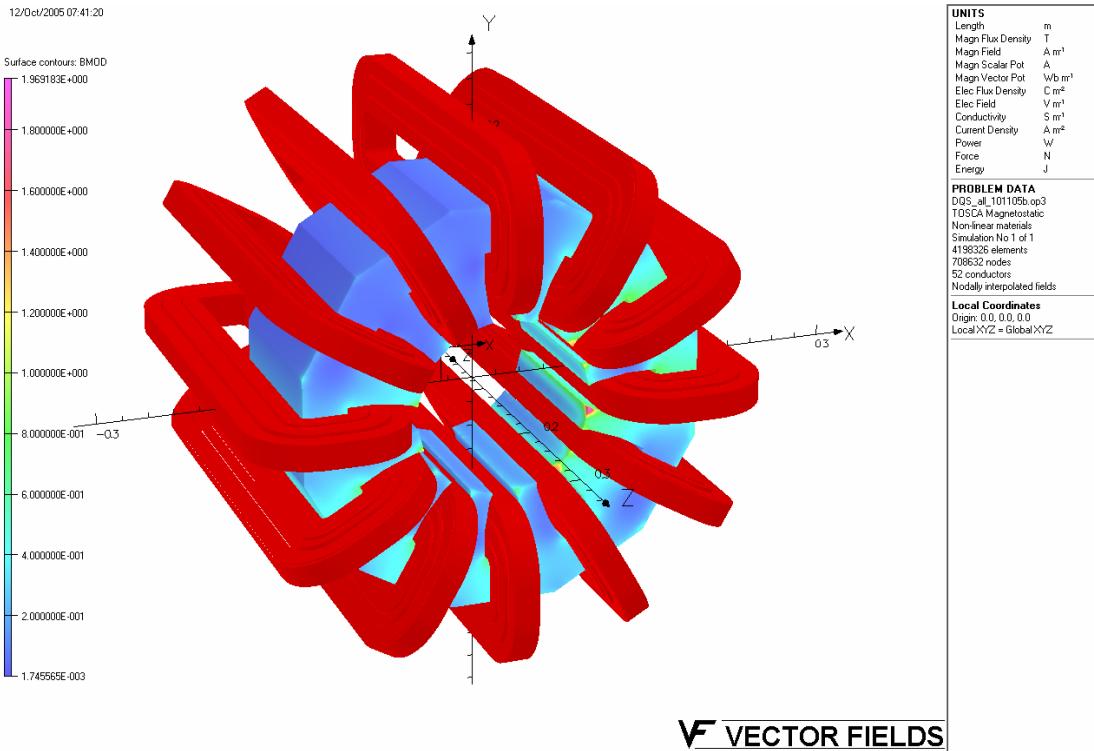


Fig. 1. Magnet geometry

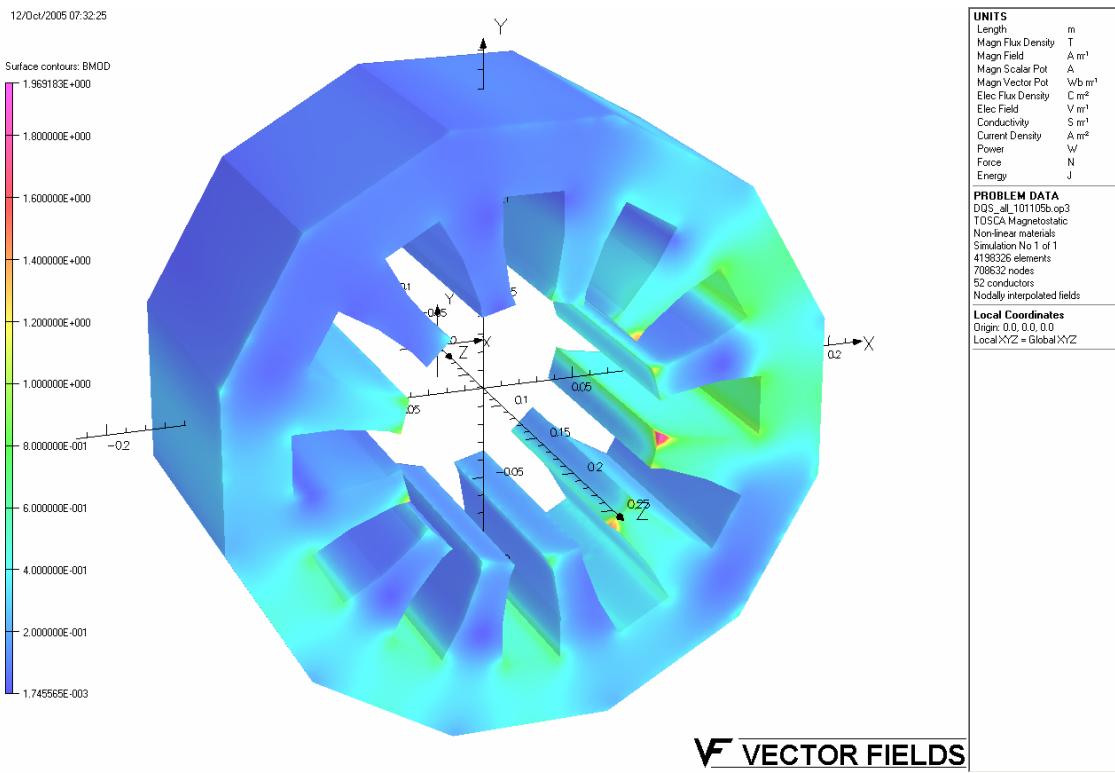


Fig. 2. Yoke flux density at maximum currents in all windings.

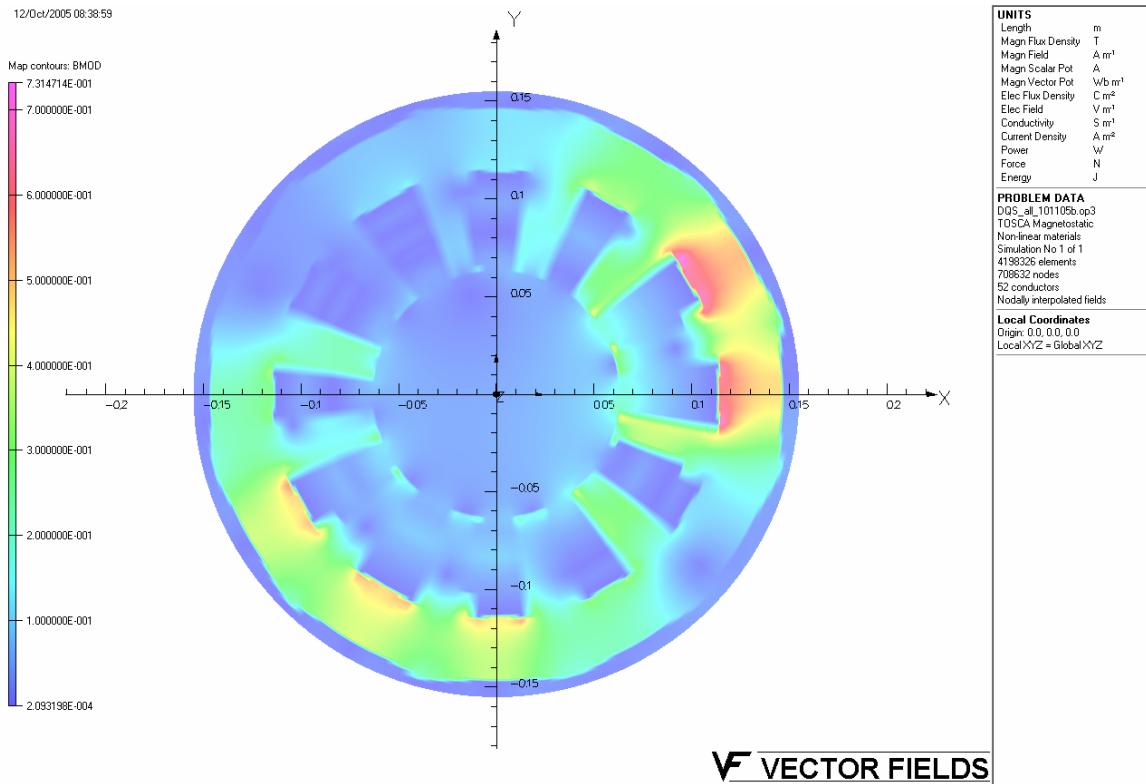


Fig. 3. Flux density in the central cross-section.

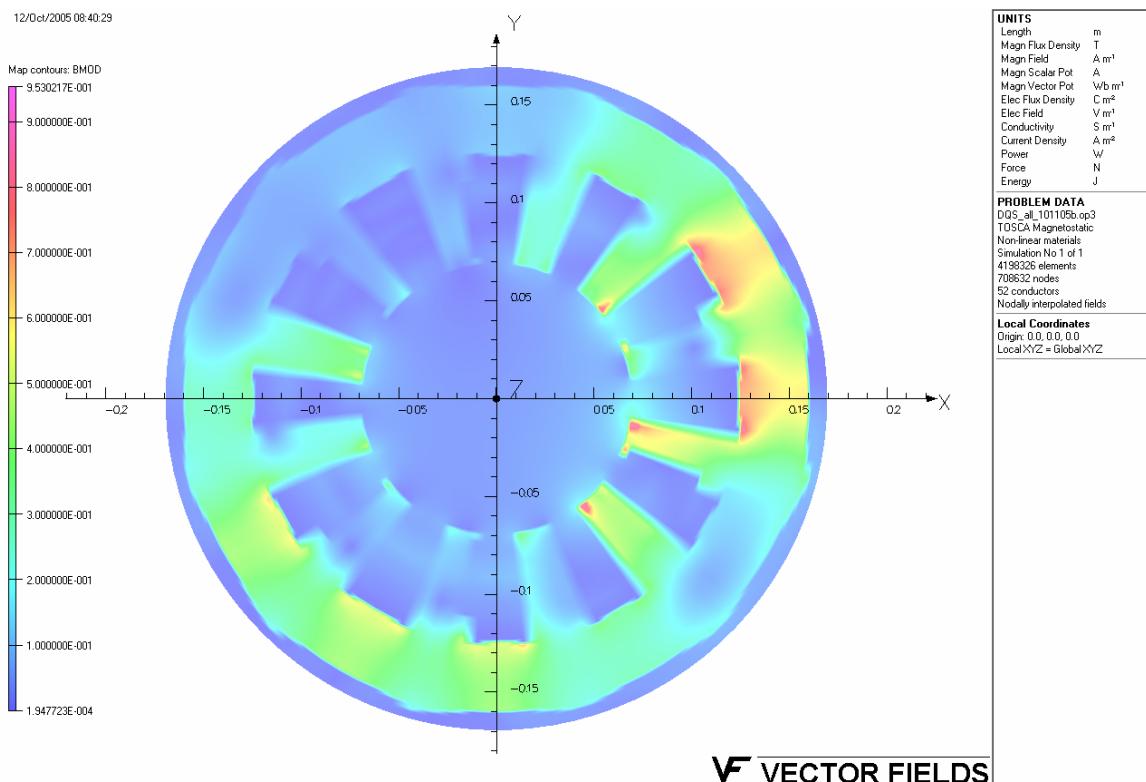


Fig. 4. Flux density at magnet core end.

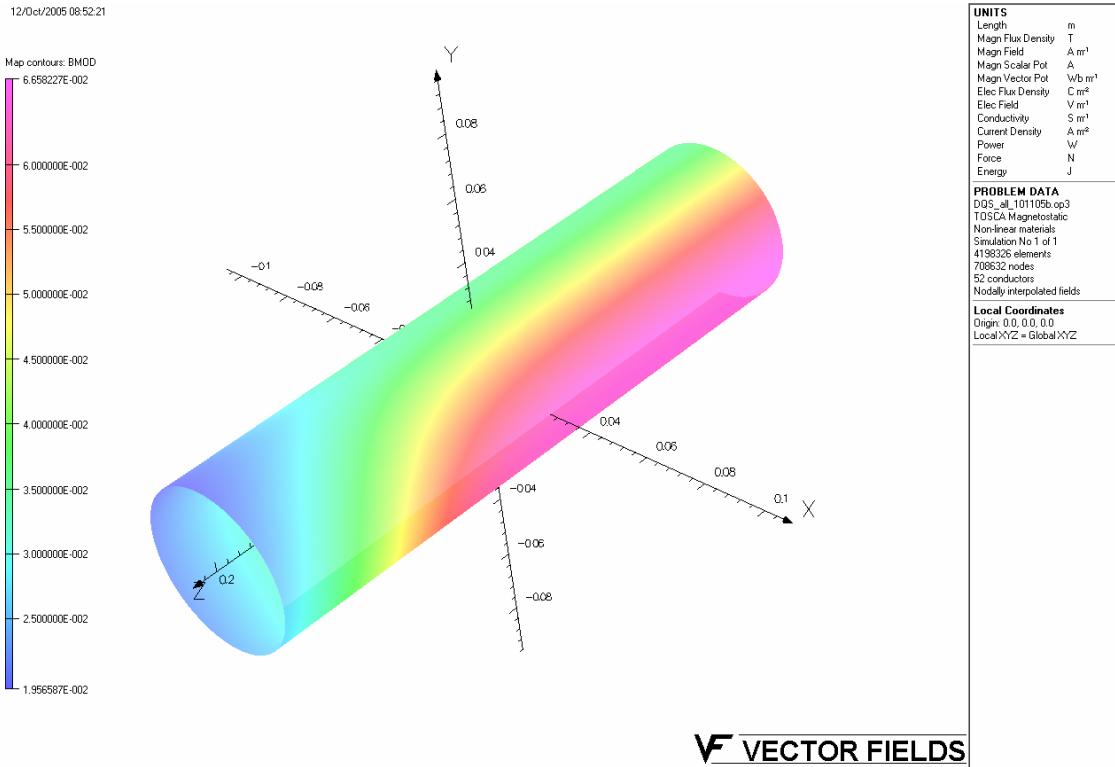


Fig. 5. Flux density at 25.4 mm radius.

Version 2. Vertical Dipole

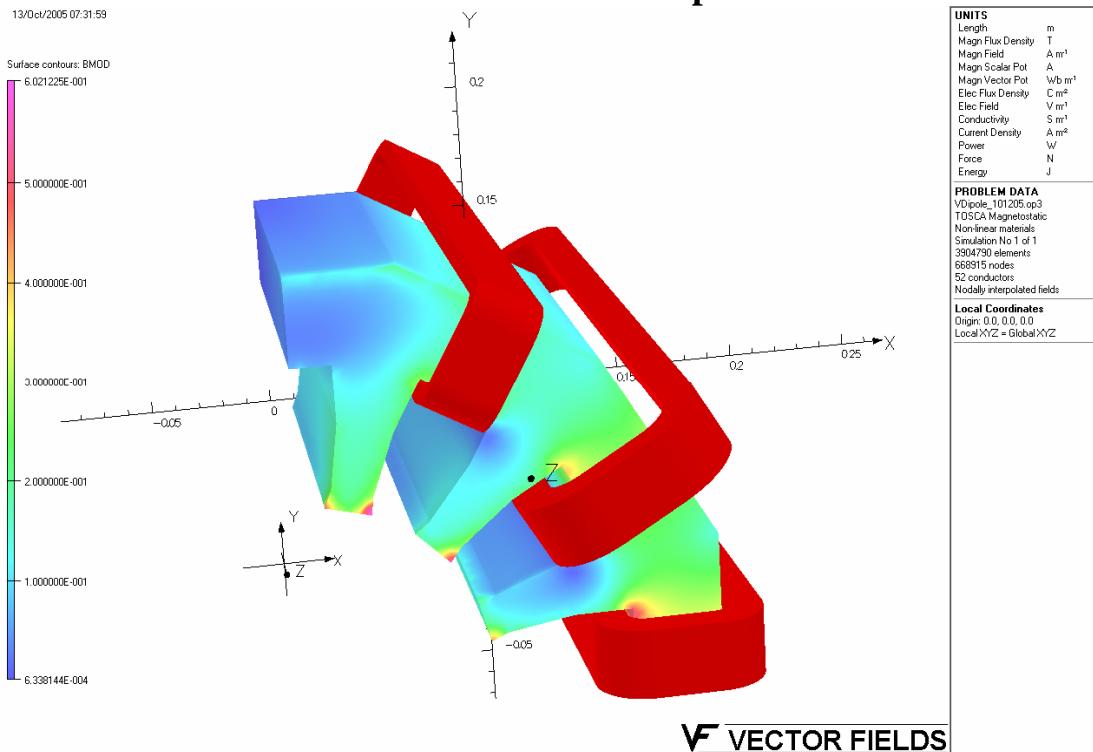


Fig. 6. Vertical dipole coils and flux density.

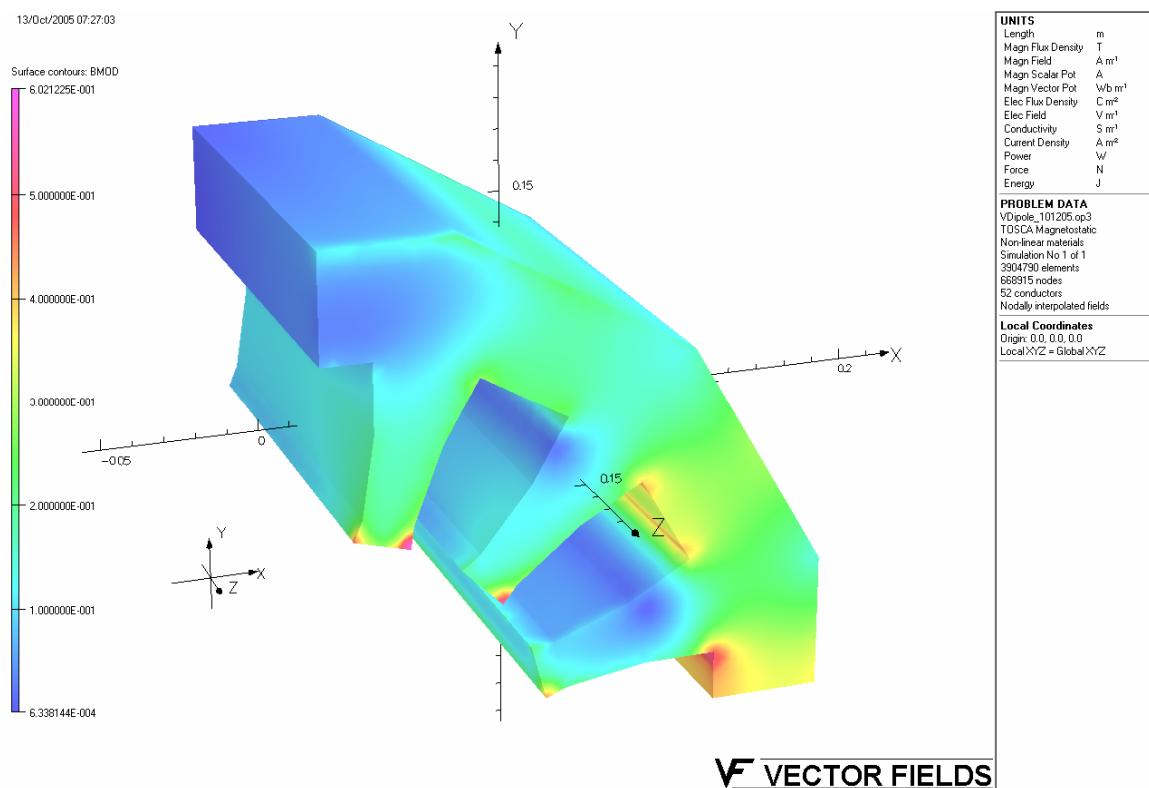


Fig. 7. Vertical dipole flux density.

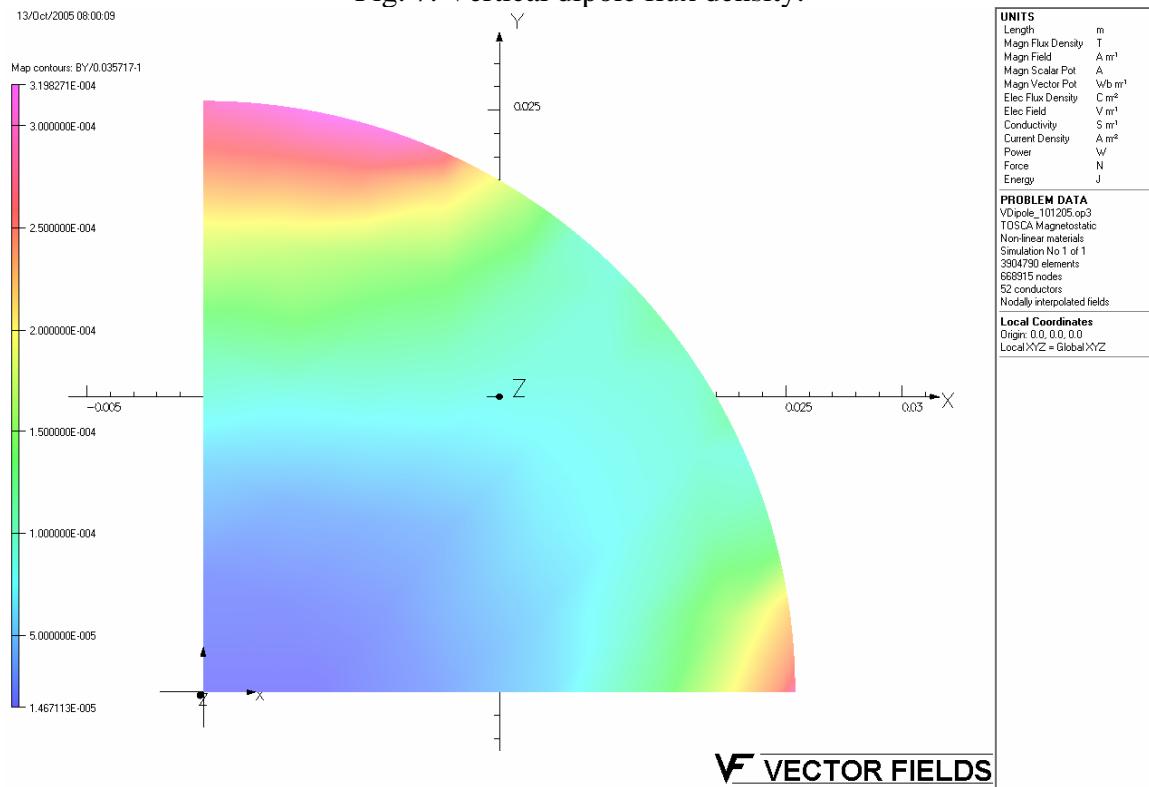


Fig. 8. Vertical dipole field homogeneity. Z=0, R=25.4 mm.

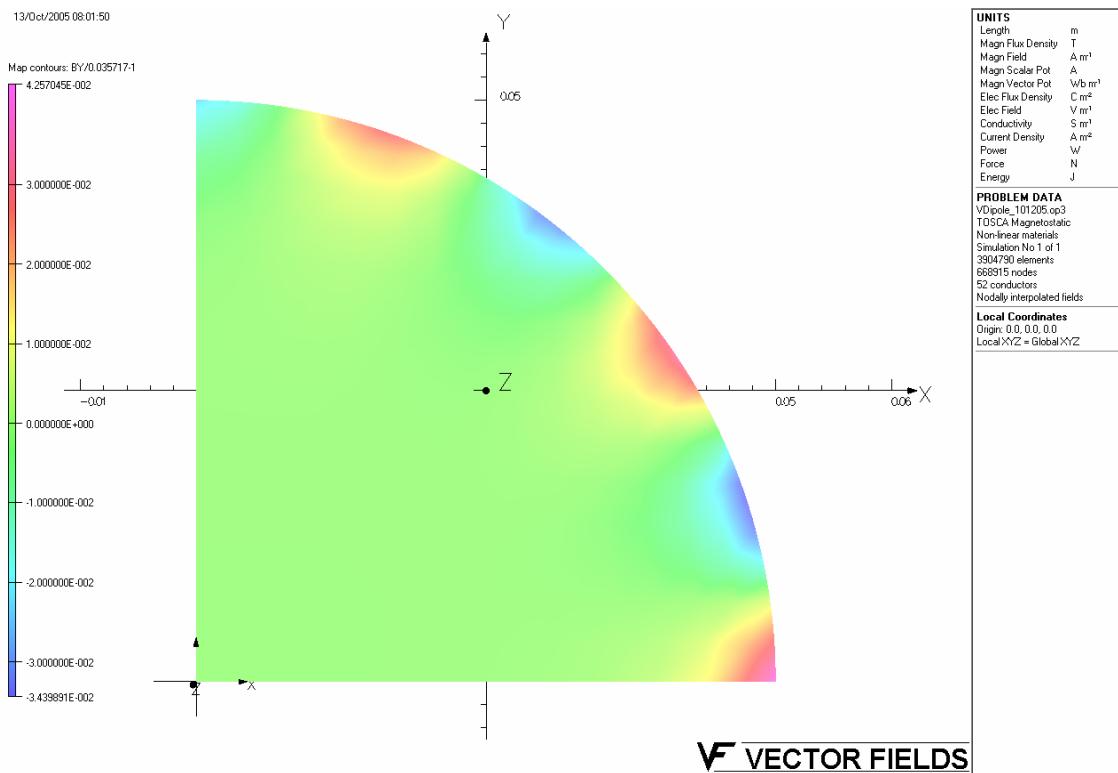


Fig. 9. Vertical dipole field homogeneity. Z=0, R=50 mm.

Version 3. Normal Quadrupole

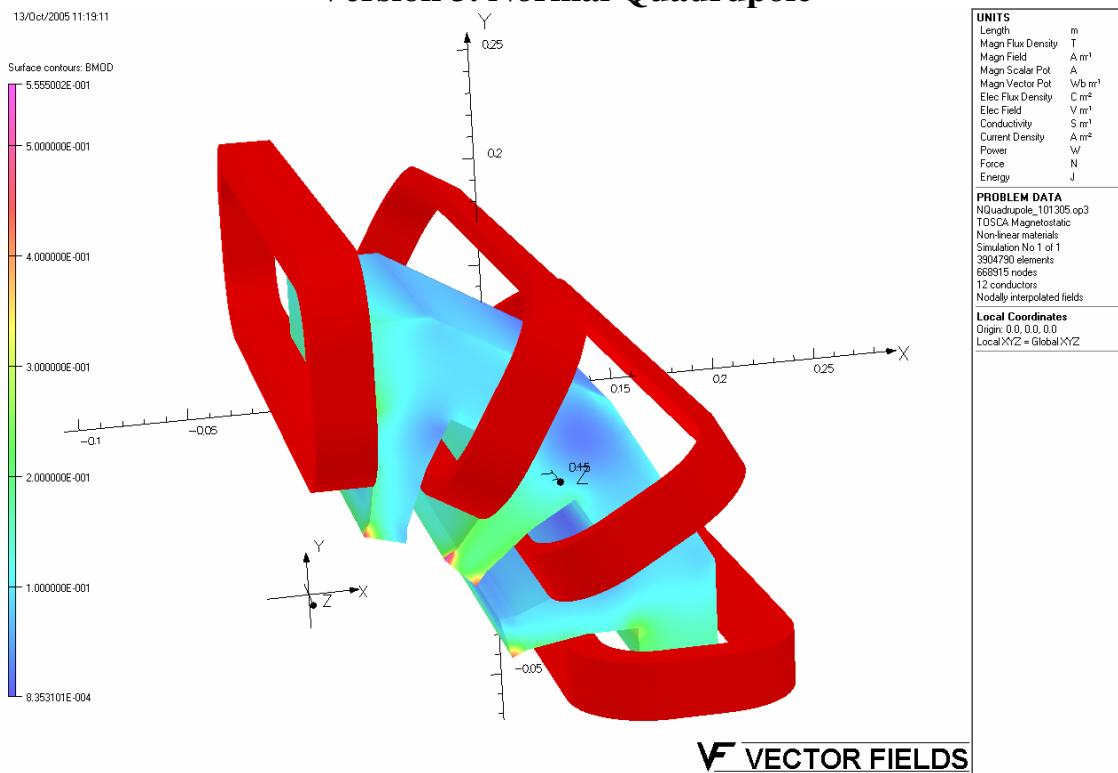


Fig. 10. Normal quadrupole coils and flux density.

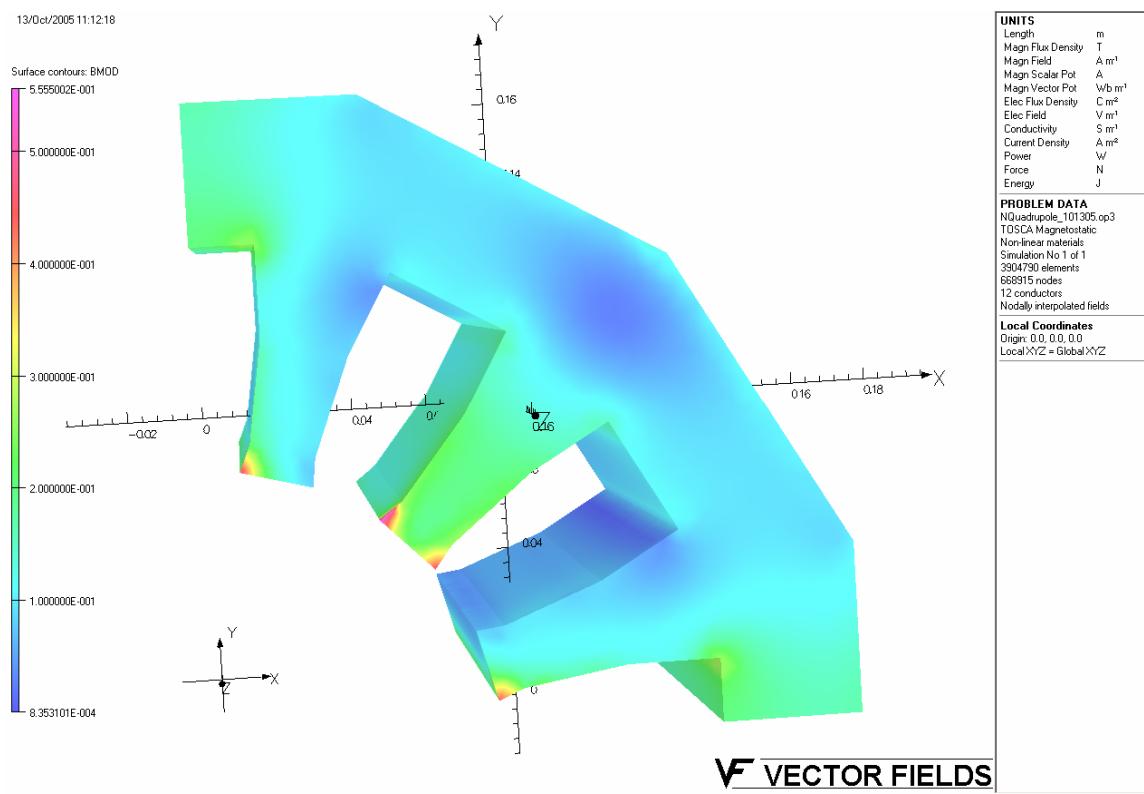


Fig. 11. Normal quadrupole flux density.

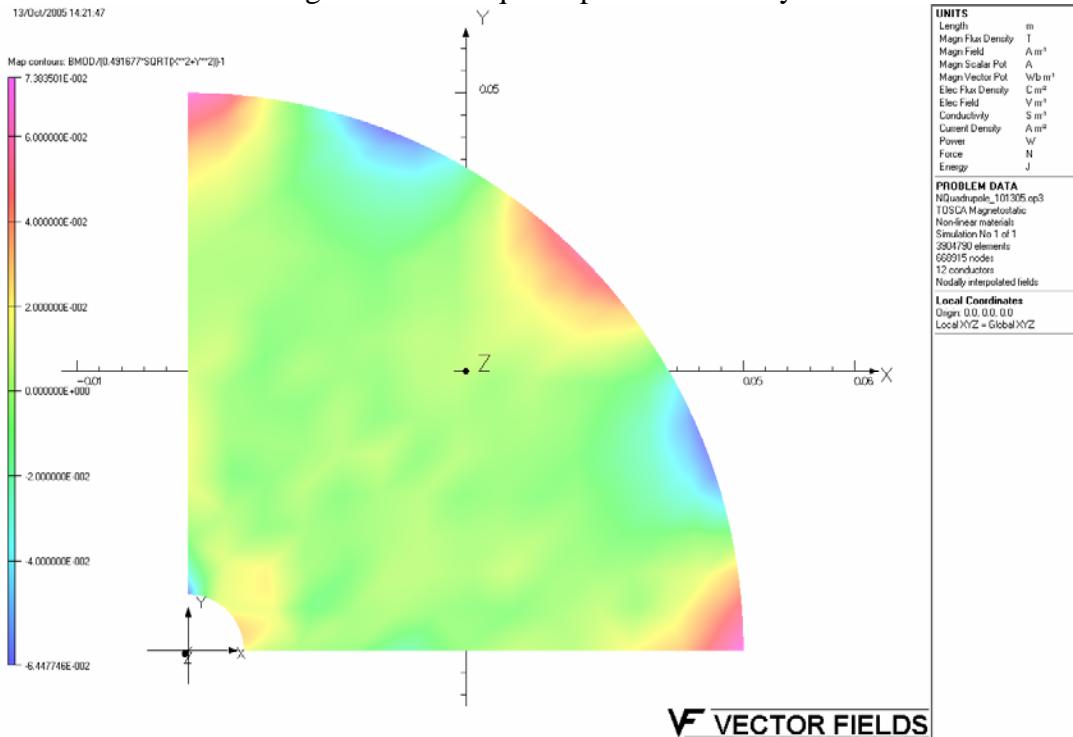


Fig. 12. Normal quadrupole field non-linearity.

Version 4. Skew Quadrupole

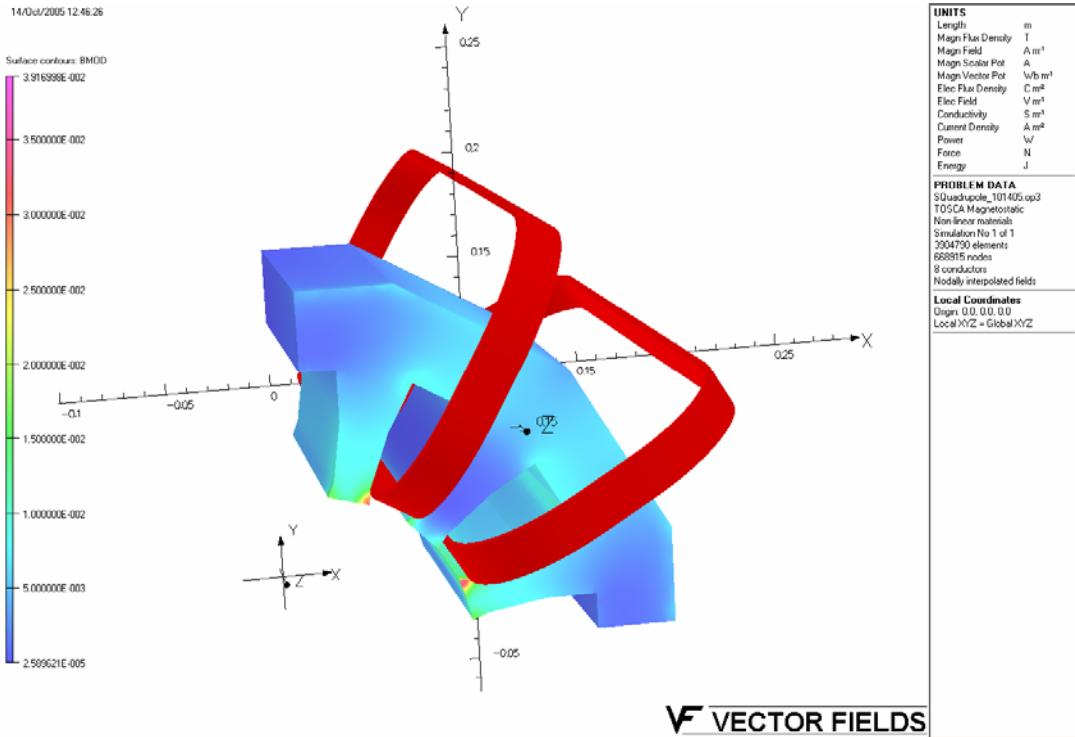


Fig. 13. Skew quadrupole geometry.

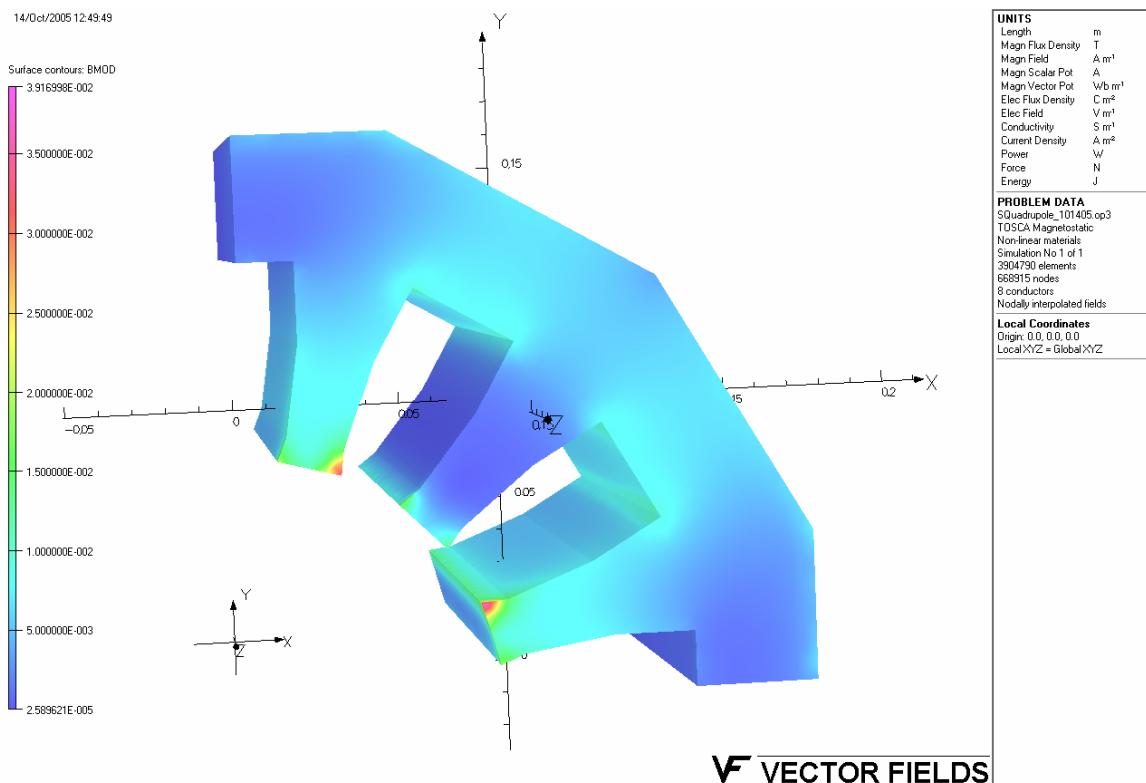


Fig. 14. Skew quadrupole flux density.

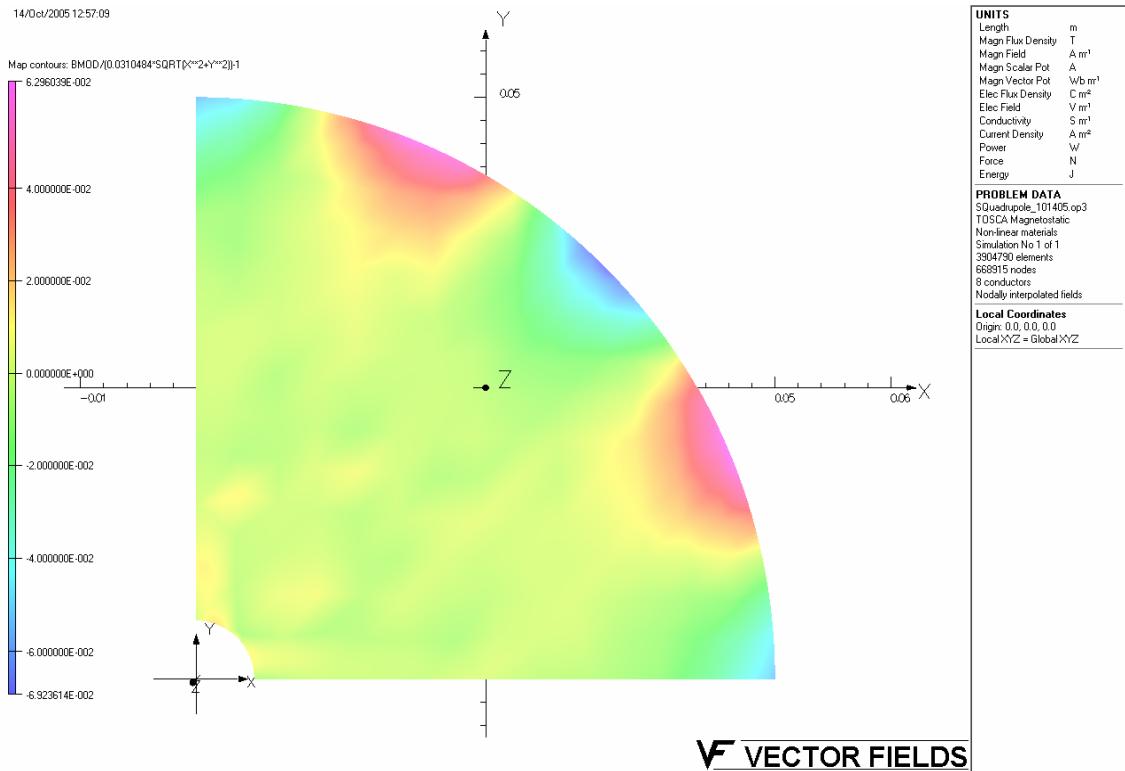


Fig. 15. Skew quadrupole field non-linearity.

Version 4. Normal Sextupole

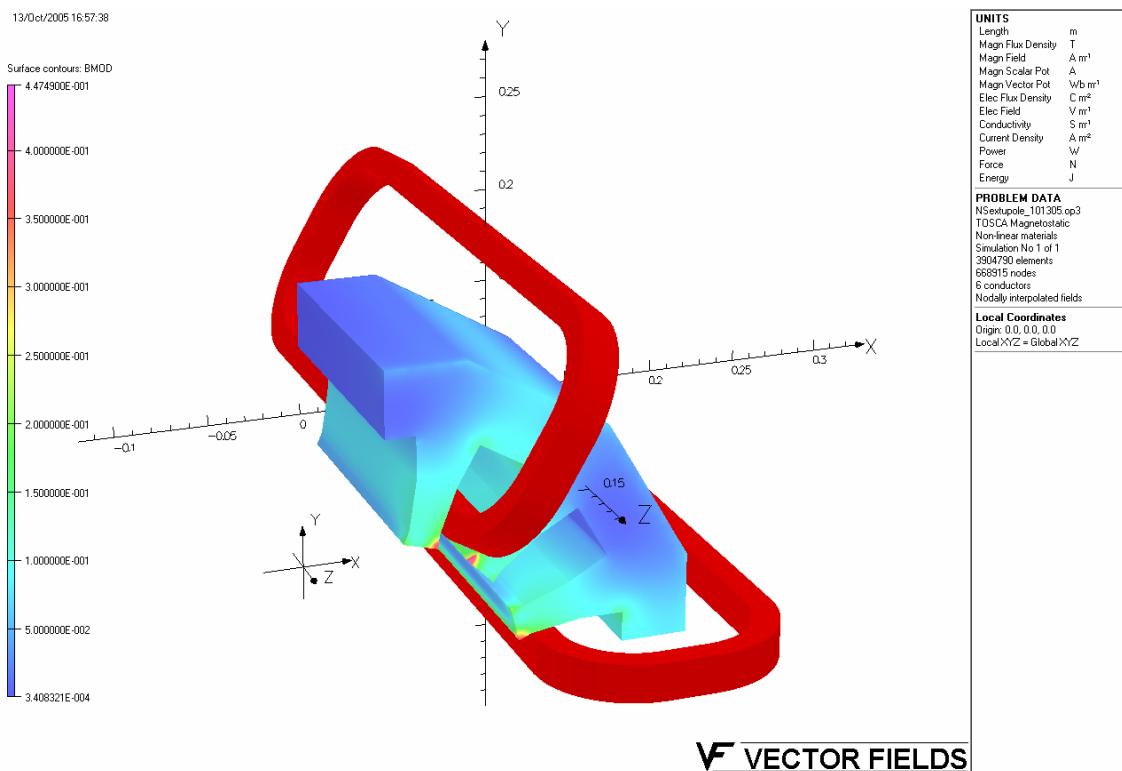


Fig. 16. Normal sextupole geometry.

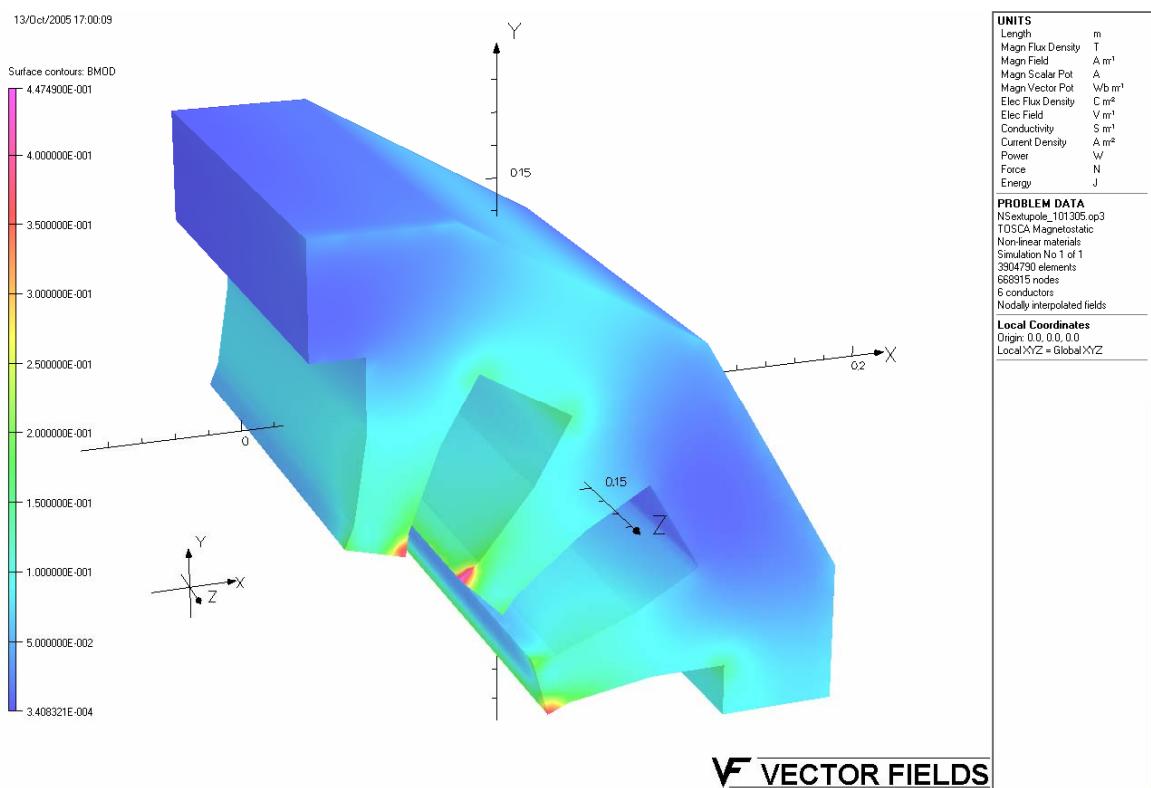


Fig. 17. Normal sextupole flux density.

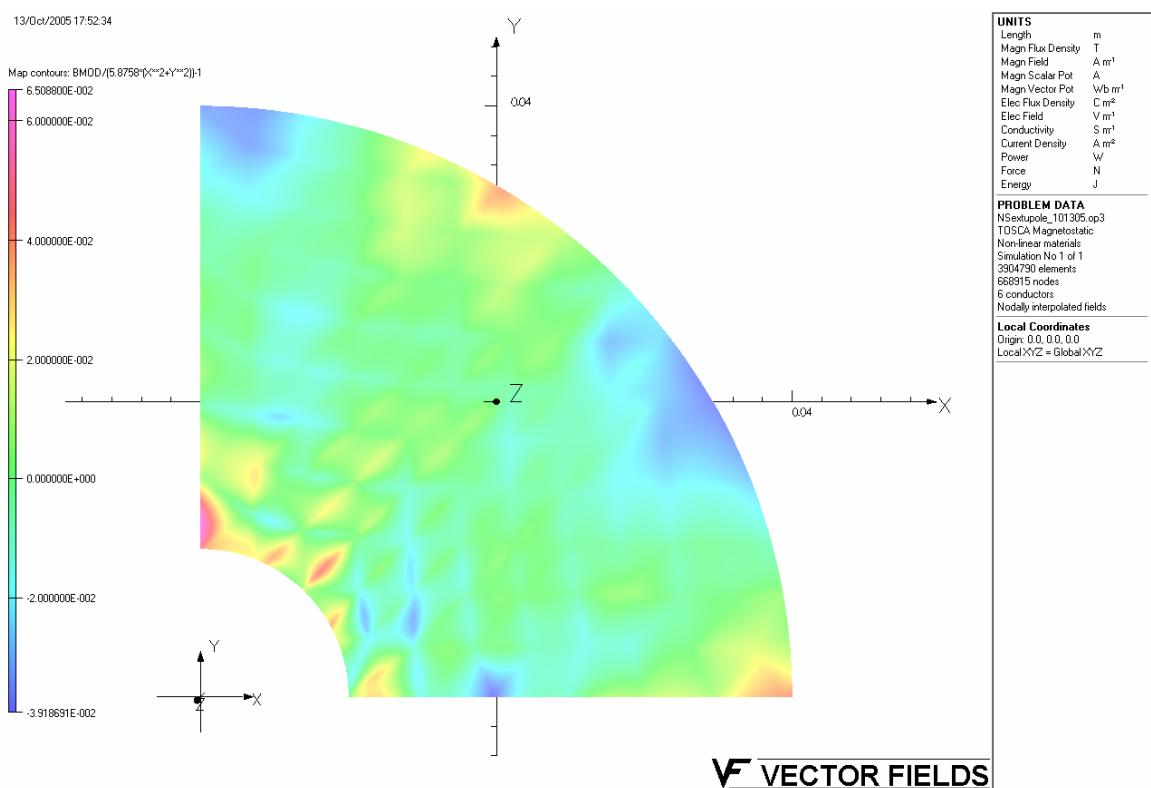


Fig. 18. Normal sextupole field quality at R= 1 - 4 cm.

Summary

The 3D analysis was made to define the main magnet parameters used for power supplies design.

The following next steps should be done for final design:

1. Measure the B-H curve of yoke steel at 15 Hz frequency and real cycle.
2. Calculate power losses in coils and yoke.
3. Estimate the eddy current effects, especially for magnet ends.
4. Calculate the 3D field quality for different coil powering scenarios.